Highlights of Astronomy, Volume 15
XXVIIth IAU General Assembly, August 2009
Ian F Corbett, ed.

DOI: 00.0000/X000000000000000X

Multiplicity Study of Exoplanet Host Stars

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Abstract. We present recent results of our ongoing multiplicity study of exoplanet host stars.

Keywords. exoplanets, multiple stars, planet formation

1. New low-mass stellar companions of exoplanet host stars

In our imaging campaign, carried out with SofI/NTT and UFTI/UKIRT, we directly detected so far several new companions of exoplanet host stars. Among them HD 3651 B the first T dwarf companion of an exoplanet host star (1 & 2), HD 27442 B a white dwarf which is the secondary of the most evolved exoplanet host star system presently known (3), as well as the binary companion of HD 65216, whose B component is a low-mass star, while HD 65216 C is either a massive brown dwarf or a very low-mass star (4).

Recently, we identified two new low-mass stellar companions of the exoplanet host stars HD 125612 and HD 212301. The co-moving companion of HD 125612 is a wide M4 dwarf ($0.18\,M_{\odot}$), located about 4750 AU southeast of its primary. The co-moving companion of HD 212301 is a close M3 dwarf ($0.35\,M_{\odot}$), which was found by us about 230 AU northwest of the exoplanet host star. The binaries HD 125612 AB and HD 212301 AB are two new members in the continuously growing list of exoplanet host star systems of which more than 40 are presently known (5).

2. Lucky-Imaging search for close companions of exoplanet host stars

We started a search for close stellar companions of exoplanet host stars at the Calar Alto Observatory in Spain, using the Lucky-Imaging technique. The observations are carried out with the 2.2 m telescope and its Lucky-Imaging camera AstraLux in the I-band. We always take several thousand short integrated images with integration times down to 30 ms, and choose a total integration time of about 30 min per target. After the standard data-reduction, our Lucky-Imaging pipeline measures the Strehl-ratios of all images, and then selects only those images with the highest Strehl-ratios (selection rates from 1 to 10%). Finally, all selected images are shifted and combined. According to the achieved AstraLux detection limit, beyond 1 arcsec ($\sim$40 AU of projected separation at the average distance of our targets) we are sensitive for all stellar companions ($> 0.08\,M_{\odot}$) around our targets. Hence, close stellar companions, which remain invisible in seeing limited observations, are clearly detectable in our AstraLux imaging campaign.

References

Mugrauer, M., Seifahrt, A., Neuhäuser, R., & Mazeh, T. 2006, *MNRAS*, 373, L31
Mugrauer, M., Seifahrt, A., Neuhäuser, R., Mazeh, T., & Schmidt, T. 2007, *IAUS*, 240, 638
Mugrauer, M., Neuhäuser, R., & Mazeh, T. 2007, *A&A*, 469, 755
Mugrauer, M., Seifahrt, A., & Neuhäuser, R. 2007, *MNRAS*, 378, 1328
Mugrauer, M., & Neuhäuser, R. 2009, *A&A*, 494, 373

Appendix A. New companions of exoplanet host stars

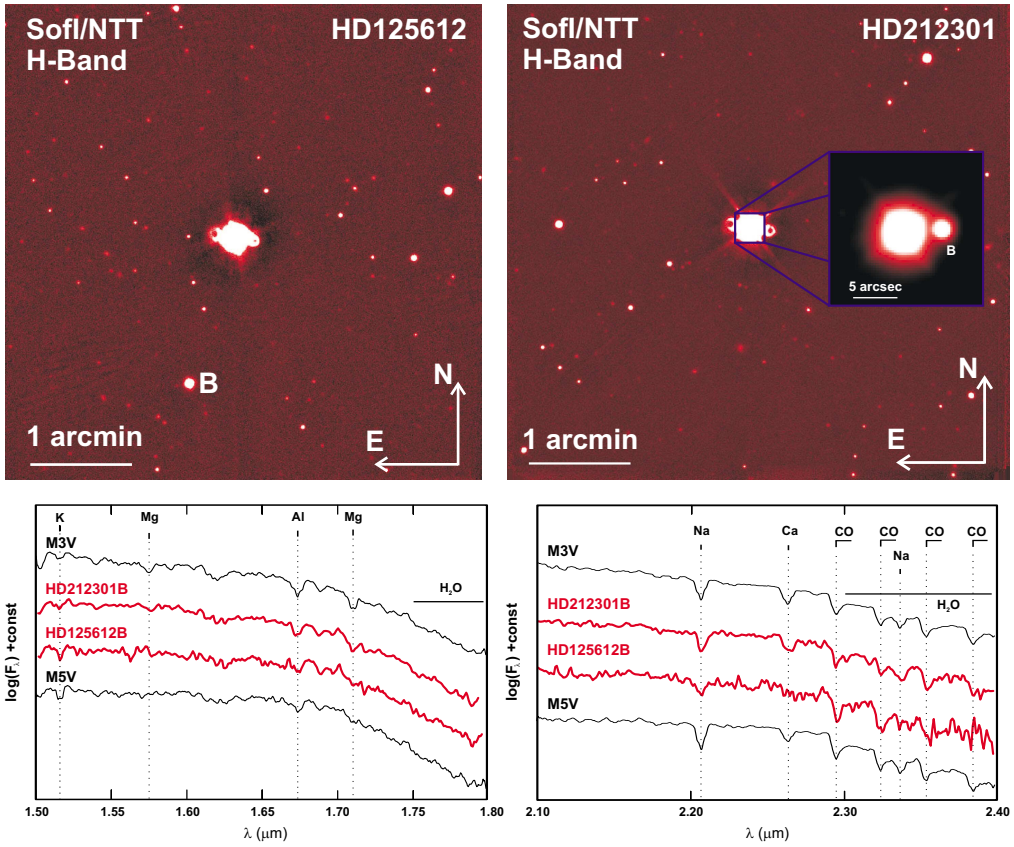

Figure 1. Top: In the course of our SofI/NTT imaging campaign, recently we identified two new low-mass stellar companions of the exoplanet host stars HD 125612 and HD 212301. Both companions clearly share the proper motions of their primaries, derived with the comparison of our SofI images, taken at different observing epochs, or by comparing our SofI data with 2MASS images, taken several years before our SofI observations. HD 125612 B is located about 1.5 arcmin south-east of its primary. HD 212301 B is located 4.4 arcsec north-west of the planet host star. **Bottom:** SofI/NTT H- and K-band follow-up spectra of HD 125612 B and HD 212301 B.

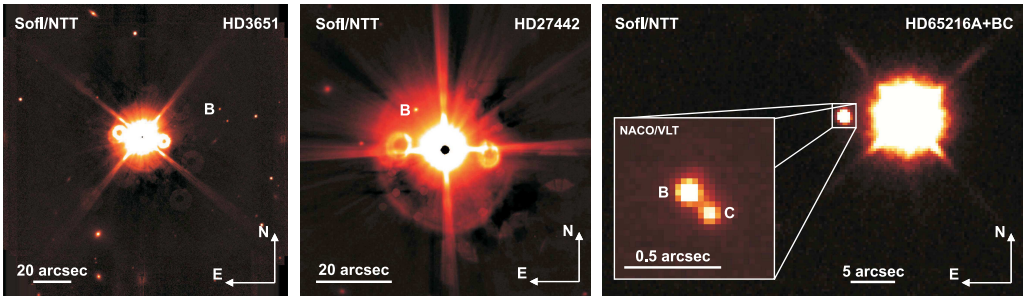

Figure 2. Left: The faint T-dwarf companion (SpT T7-8) to the planet host star HD3651, detected by us with SofI/NTT and UFTI/UKIRT in the H-band. The companion clearly shares the proper motion of its primary from which it is separated by about 43 arcsec (∼480 AU of projected separation). **Middle:** The co-moving companion of the exoplanet host star HD 27442, imaged with SofI/NTT in the H-band. HD 27442 B is located 12.9 arcsec (∼240 AU of projected separation) north-east of the planet host star. The photometry of the companion is fully consistent with a relatively young white dwarf ($T \sim 14400$ K, and cooling age of about 220 Myr), confirmed by spectroscopy. HD 27442 B shows Hydrogen absorption features of the Balmer, Paschen, and Bracket series in its optical and infrared spectra. With its subgiant primary and the white dwarf companion, HD 27442 AB is the most evolved exoplanet host star system presently known. **Right:** The exoplanet host star HD 65216 with its binary companion HD 65216 BC, located about 7 arcsec (∼250 AU of projected separation) east of its primary. While HD 65216 B (0.089 $M_\odot$, SpT M7-8) is a low-mass star, HD 65216 C (0.078 $M_\odot$, SpT L2-3) could be either a massive brown dwarf or a very low-mass star.

Appendix B. Lucky-Imaging search for close stellar companions of exoplanet host stars with AstraLux

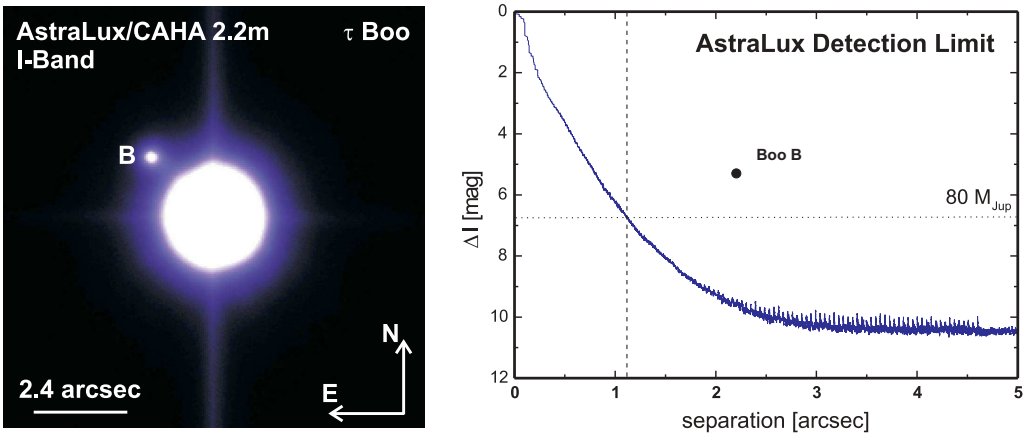

Figure 3. As an example of our Lucky-Imaging observations, we show here the exoplanet host star τ Boo with its close stellar companion τ Boo B (0.44 $M_\odot$), imaged by us with AstraLux. The companion is located about 2.2 arcsec (∼34 AU of projected separation) north-east of its primary. The magnitude difference between the companion and the planet host star is $\Delta I = 5.3$ mag. According to the achieved AstraLux detection limit, companions like τ Boo B can easily be imaged around all our targets. In particular, beyond 1 arcsec (∼40 AU of projected separation at the average distance of our targets) all stellar companions (>80 M_{Jup}) are detectable around all targets.